Reproductive phases in relation to yield and seed quality in soybean*

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Abstract

This experiment was conducted to determine(i) The effect of plant type on various reproductive phase intervals, (ii) Heritability of various reproductive phase intervals and their relationship with yield and seed quality. Twenty five varieties, differing in their crop duration were evaluated over 2 years viz. rainy season 1992 and 1993.

Plant type did ont affect reproductive phase intervals except $R_1 - R_2$ period. Heritability estimates for all the reproductive phase intervals were relatively high (0.74). The lengh of filling period ($R_6 - R_7$) was negatively, nonsignificantly correlated with seed longevity and positively, nonsignificantly correated with seed yield and seed size. The total reproductive interval could be used as initial selection criterion for identifying lines with long seed filling poriod. Seed longevity was positively, significantly correlated with days to flowering

High yield and good seed quality are desitable traits in soybean, Greater seed yield is related to a longer reproductive of seed filling period and determinate habit growth of plant, however, Wilcox (1980) reported similar yield of semideterminate and indeterminate when both the types had equal maturity. Goley et al. (1986) found that stem termination types did not differ significantly for yield. The high yield potential should be accompanied with good quality since low seed quality will lead to poor germination, slow emergence, and inadequate plant stand resulting into weed problems and reduced seed yield

Several workers have reported that soybean seed attains its highest potential quality at physiological maturity. Thus reproductive stage intervals assume significance in relation to seed quality. Vaughan (1987) found that the longer the period $R_6 - R_7$, the larger seed obtained, and hence poorer the seed quality. Song et al. (1988) also observed positive correlation between fruiting period and seed weight while Pfeiffer and Egli (1998) found that seed size was rarely correlated with filling period. In view of these

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conflicting reports and considering the importance of seed quality the present investigation was conducted to determine the effect of plant growth habit on various reproductive phase intervals; heritability of reproductive phase intervals and their relationship to yield and seed quality

Material and methods

The experimental materials consisted 25 varieties (16 determinates and 9 indeterminates) planted in randomized block design with 4 replications in rainy season 1992 and 1993 at Crop Research Center of the University. During plant development continuous observations for reproductive phases were take on five randomly selected plants from a plot following Fehr and Caviness (1977). Laboratory germination of fresh and room temperature stored seeds (for 8 months) was carried out. Corellations between seed germinability, yield and repeoductive phase intervals were worked out.

Results and discussions

Days taken between various reproductive stages were more or less equal irrespective of growth habit except $R_1 - R_2$ and $R_5 - R_7$. The R_1 and R_2 stages occurred simultaneously in determinate varieties (days intervals: 0.25–1.67) in contrast to the indeterminate varieties where there was sufficient gap between stages (1.33–3.00 days). The length of seed filling period ($R_5 - R_7$) in determinate cultivars was rather longer than that in the indeterminate types (30.12 and 26.34 days, respectively). Fehr and Caviness (1977) also observed more or less similar results except days taken to develop from $R_5 - R_6$, where, in the present study, it was 6.47 days (determunate) and 7.91 days (indeterminate) but Fehr and Caviness (1977) reported that days required to develop from $R_5 - R_6$ averaged 15 days. The discrepancies can be explained due to the fact that data of the Fehr and Caviness was from studies conducted in USA and the durations may differ from place to place as soybean development is influenced by temperature, day length, variety and other factors. Low temperature retard and high temperature enhance reproductive development. Long days (short nights) retard and short day enhance reproductive development. The results of this investigation confirmed the findings of Bhatacharya (1990).

The heritability estimates for various reproductive phase intervals were relatively high (> 0.74) indicating that the selection for the length of this intervals may be effective. The high heritability estimates for total reproductive period ($R_1 - R_8$) was reported by Burton (1987), Pfeiffer and Egli (1988), for filing period was reported by Hanson (1985). Smith and Nelson (1987); obtained heritability estimates of 0.24–0.20 for $R_5 - R_7$ in two populations of determinate soybean, Salado–Navarro et al. (1985) obtained 0.07 and 0.41 for R_5 to R_7 as broad sense heritability.

The yield obtained from determinate genotyper was rather higher than that from indeterminate ones (sbout 1–2q/ha) in boths years of experiment. The low yield in the indeterminate cultivars may be due to excessive lodging and due to the fact that in this

type of plant habit sunstantial stem elongation and leaf production continue longer after the onset of blooming suggesting a strong competition for assimilates between reproductive and vegetative "sink". Thus some reduction of vegetative growth has been thought desirable in indeterminates cultivars to minimize the abortion of reproductive structures and consequently to increase seed yield. Foley et al. (1986) reported that stem termination type did not cause significant yield differences. Thus, either of the phenotypes (determinate vs indeterminate) could be successfully used in soybean breeding programme depending upon other conditions, for example, in situation causing inadequate vegetative growth (late planted, planted near equator or soybean of 00, 0, I, II maturity group), it would be desirable to develop indeterminate cultivars (Boerma, 1979). It is, therefore, suggested that for the Southern India, indeterminate/semi- determinate cultivars may be better plant type and in North India, determinate tall, plant type will be the desirable type.

A critical examination of data in table 2, 3 revealed that seed yield had negative correlation with all intervals $R_1 - R_2$, $R_2 - R_3$, $R_3 - R_4$, $R_4 - R_5$, $R_5 - R_6$, $R_1 - R_8$, R_1 and R_8 positive correlation with $R_6 - R_7$ and $R_5 - R_7$. However, these correlations were non-significant, except with $R_3 - R_4$. No correlation could be observed between seed yield and germination percentage after room temperature storage. Similary, Hanson (1985) did not find association between pod initiation and establishment ($R_1 - R_5$) with seed yield. Anand and Torrie (1963) found genotypic correlation between length of fruiting period and seed yield was only 0.29.

The seed filling period ($R_5 - R_7$) was significantly, positively correlated with total reproductive phase and negatively with flowering date. Thus the time between flowering and maturity could be used as an initial selection criterion for identifying lines with long seed filling duration.

The storbility potential of indeterminate was better than that of determinate ones. The laboratory germination of fresh seed had positive correlation with reproductive phase intervals: $R_1 - R_2$, $R_5 - R_6$, R_1 and R_8 and negative nonsignificant correlation with fruiting period ($R_5 - R_7$). The trend was similar for the laboratory germination of stored seeds in both the years of experiment.

Seed size has been found to be negatively associated with germinability / storability and postitvely, nonsignificantly correlated with filling period (0.175 in 1992 and 0.230 in 1993). Similarly, Song et al. (1988), reported a positive correlation of fruiting period with seed weight, hence nreeding for smallet seed is recommended to improve seed quality. However, Pfeiffer and Egli (1988) found that seed size was raely correlated with filling period.

Thus, on the basis of overall results, major emphasis can not be put on $R_5 - R_7$ to have a significant bearing on seed yield and quality in the present material.

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大豆生殖生长阶段与产量及种子质量的相关研究

摘 要

本试验的目的是明确: (1)株型对各生殖生长阶段长度的影响; (2)各生殖生长阶段长度的遗传力及其与产量和种子质量的相关。试验用 25 个生育期不同的品种于 1992和 1993年的雨季进行。

除 R_1- R_2期外,株型不影响其它生殖生长阶段长度。所有生殖生长阶段长度的遗传力都较高 (> 0. 74)。鼓粒期 (R_2- R_7)长度与种子寿命呈不显著负相关,与种子产量及种子大小呈不显著正相关。总生殖生长期长度可作为选择长鼓粒期品系的初始选择指标。种子寿命与开花前日数间存在显著的正相关。